

CLAIMS:

1. A non-transparent tape manufacturing system comprising:
 - (a) a tape-processing unit;
 - (b) a tape handler for providing at least one tape to the tape-processing
 - 5 unit; and
 - (c) at least one tape-surface-inspection unit for characterizing the surface of the at least one tape provided to the tape-processing unit.
2. The tape manufacturing system according to Claim 1, further including at least one controller in communication with the tape-processing unit, the tape handler, and the
- 10 tape-surface-inspection unit.
3. The tape manufacturing system according to Claim 2, wherein the controller regulates the rate at which the tape handler provides the tape.
4. The tape manufacturing system according to Claim 2, wherein the controller regulates the residence time of the tape in the tape-processing unit.
- 15 5. The tape manufacturing system according to Claim 2, wherein the controller communicates that the tape is acceptable for further manufacturing.
6. The tape manufacturing system according to Claim 2, wherein the controller communicates that the manufactured tape is unacceptable for further manufacturing.
7. The tape manufacturing system according to Claim 2, wherein the
- 20 tape-processing unit is a polishing operation.
8. The tape manufacturing system according to Claim 7, wherein the polishing operation includes at least one mechanical polishing operation.
9. The tape manufacturing system according to Claim 7, wherein the polishing operation includes at least one chemical polishing operation.
- 25 10. The tape manufacturing system according to Claim 7, wherein the polishing operation includes at least one electrical polishing operation.
11. The tape manufacturing system according to Claim 2, wherein the tape-processing unit comprises at least one rolling operation.
12. The tape manufacturing system according to Claim 11, wherein the rolling
- 30 operation further includes at least one texturizing unit.

13. The tape manufacturing system according to Claim 12, wherein the texturizing unit comprises at least one heat-treating unit.

14. The tape manufacturing system according to Claim 2, wherein the tape-processing unit comprises at least one coating operation.

5 15. The tape manufacturing system according to Claim 14, wherein the coating operation comprises at least one physical coating operation.

16. The tape manufacturing system according to Claim 15, wherein the physical coating operation comprises at least one ion beam-based coating operation.

10 17. The tape manufacturing system according to Claim 16, wherein the coating operation comprises at least one ion beam assisted deposition coating operation.

18. The tape manufacturing system according to Claim 14, wherein the coating operation comprises at least one chemical coating operation.

19. The tape manufacturing system according to Claim 18, wherein the chemical coating operation comprises at least one chemical vapor deposition operation.

15 20. The tape manufacturing system according to Claim 19, wherein the chemical vapor deposition operation comprises at least one metalorganic chemical vapor deposition (MOCVD) operation.

21. The tape manufacturing system according to Claim 2, wherein the tape-processing unit comprises at least one cleaning operation.

20 22. The tape manufacturing system according to Claim 2, wherein the tape handler comprises at least one tape translation mechanism.

23. The tape manufacturing system according to Claim 22, wherein the tape translation mechanism comprises at least one reel-to-reel unit.

25 24. The tape manufacturing system according to Claim 22, wherein the tape translation mechanism comprises at least one conveyor.

25. The tape manufacturing system according to Claim 22, wherein the tape translation system comprises at least one robotic translator.

26. A tape-surface-inspection unit capable of continuously inspecting a tape, the tape-surface-inspection unit including:

30 (a) a surface illuminator for illuminating a tape surface

(b) an imager for imaging the illuminated tape surface;
(c) an image processor for processing the tape surface image so as to allow the characterization of the tape surface;

(d) a tape guide for locating the tape with respect to the imager; and

5 (e) an indexer for permitting a correlation between a location along the tape and a characterization of the location on the tape.

27. The tape-surface-inspection unit according to Claim 26, wherein the indexer comprises at least one scanner based system.

10 28. The tape-surface-inspection unit according to Claim 27, wherein the scanner based system scans for at least one fiducial mark.

29. The tape-surface-inspection unit according to Claim 28 wherein the fiducial mark comprises at least one matrix of dots.

30. The tape-surface-inspection unit according to Claim 28 wherein the fiducial mark is alphanumeric.

15 31. The tape-surface-inspection unit according to Claim 28 wherein the fiducial mark comprises at least one barcode.

32. The tape-surface-inspection unit according to Claim 26 wherein the imager comprises at least one camera.

20 33. The tape-surface-inspection unit according to Claim 32 wherein the camera is a digital camera.

34. The tape-surface-inspection unit according to Claim 33 wherein the digital camera is a color digital camera.

35. The tape-surface-inspection unit according to Claim 26 wherein the imager comprises at least one microscope.

25 36. The tape-surface-inspection unit according to Claim 35 wherein the microscope further includes at least one camera.

37. The tape-surface-inspection unit according to Claim 36 wherein the camera is a digital camera.

30 38. The tape-surface-inspection unit according to Claim 37 wherein the digital camera is a color digital camera.

39. The tape-surface-inspection unit according to Claim 26 wherein the imager comprises at least one human.

40. The tape-surface-inspection unit according to Claim 26 wherein the image processor further includes at least one data storage device.

5 41. The tape-surface-inspection unit according to Claim 26 wherein the image processor further includes at least one data indexer for retrievably storing image data.

42. The tape-surface-inspection unit according to Claim 26 wherein the image processor further includes at least one image data analyzer.

10 43. The tape-surface-inspection unit according to Claim 42 wherein the image data analyzer comprises at least one characteristic identifier.

44. The tape-surface-inspection unit according to Claim 43 wherein the characteristic identifier identifies at least one of a plurality of surface particles.

15 45. The tape-surface-inspection unit according to Claim 44 wherein the characteristic identifier determines at least one of surface particle aerial density, surface particle linear density, surface particle aerial density and surface particle linear density.

46. The tape-surface-inspection unit according to Claim 44 wherein the characteristic identifier determines surface particle shape.

47. The tape-surface-inspection unit according to Claim 44 wherein the characteristic identifier determines surface particle size.

20 48. The tape-surface-inspection unit according to Claim 43 wherein the characteristic identifier identifies surface scratches.

49. The tape-surface-inspection unit according to Claim 48 wherein the characteristic identifier determines scratch size.

25 50. The tape-surface-inspection unit according to Claim 48 wherein the characteristic identifier determines scratch shape.

51. The tape-surface-inspection unit according to Claim 48 wherein the characteristic identifier determines scratch orientation.

30 52. The tape-surface-inspection unit according to Claim 48 wherein the characteristic identifier determines at least one of scratch aerial density, scratch linear density, scratch aerial density and scratch linear density.

53. The tape-surface-inspection unit according to Claim 26 wherein the image processor further comprises at least one data output.

54. The tape-surface-inspection unit according to Claim 53 wherein the data output provides data in any form of any one of raw data, analyzed data, and raw data and analyzed data.

55. The tape-surface-inspection unit according to Claim 54 wherein the data output provides pictorial data.

56. The tape-surface-inspection unit according to Claim 54 wherein the data output provides graphical data.

57. The tape-surface-inspection unit according to Claim 56 wherein the output graphical data comprises at least one histogram of characteristic density.

58. The tape-surface-inspection unit according to Claim 54 wherein the data output provides numerical data.

59. The tape-surface-inspection unit according to Claim 58 wherein the output numerical data is a characteristic area fraction.

60. The tape-surface-inspection unit according to Claim 58 wherein the output numerical data comprises at least one grain size of the tape.

61. The tape-surface-inspection unit according to Claim 26 wherein the tape guide comprises at least one field of view guide for locating the tape in the field of view of the imager.

62. The tape-surface-inspection unit according to Claim 26 wherein the tape guide is a focal position guide for locating the tape surface in the focal position of the imager.

63. The tape-surface-inspection unit according to Claim 62 wherein the focal position guide comprises at least one distance guide.

64. The tape-surface-inspection unit according to Claim 62 wherein the focal position guide comprises at least one flatness conditioner for maintaining the tape substantially flat.

65. The tape-surface-inspection unit according to Claim 26 wherein a portion of the tape guide that is adjacent the tape comprises a composition selected to be compatible with the composition of the tape so as to not cause defects to the tape.

66. The tape-surface-inspection unit according to Claim 65 wherein the composition is selected so as to be non-contaminating to the tape.

67. The tape-surface-inspection unit according to Claim 65 wherein the composition is selected so as to be non-deforming to the tape.

5 68. The tape-surface-inspection unit according to Claim 65 wherein the composition is a fluorocarbon.

69. The tape-surface-inspection unit according to Claim 68 wherein the fluorocarbon is a polytetrafluoroethylene.

70. The tape-surface-inspection unit according to Claim 26 wherein the
10 surface illuminator comprises at least one light source providing electromagnetic radiation in the optical spectrum.

71. The tape-surface-inspection unit according to Claim 70 wherein an intensity of the electromagnetic radiation provided by the light source is adjustable.

72. The tape-surface-inspection unit according to Claim 70 wherein an angle
15 of incidence of the electromagnetic radiation provided by the light source is adjustable.

73. The tape-surface-inspection unit according to Claim 72 wherein the angle of incidence of the electromagnetic radiation provided by the light source is substantially normal to the tape surface.

74. The tape-surface-inspection unit according to Claim 72 wherein the
20 incident electromagnetic radiation provided by the light source is substantially oblique to the tape surface.

75. The tape-surface-inspection unit according to Claim 74 wherein the oblique angle is in the range between about 10 and about 20 degrees with respect to the plane of the tape surface.

25 76. The tape-surface-inspection unit according to Claim 72 wherein the angle of incidence of the electromagnetic radiation provided by the light source is a combination of substantially normal and substantially oblique to the tape surface.

77. The tape-surface-inspection unit according to Claim 70 wherein the light source comprises at least one ring light.

78. The tape-surface-inspection unit according to Claim 70 wherein the light source comprises at least one gooseneck light.

79. A tape manufacturing system comprising:

(a) a tape-processing unit;

5 (b) a tape handler for providing at least one tape to the tape-processing unit;

(c) at least one tape-surface-inspection unit capable of continuously characterizing the surface of the at least one tape provided to the tape-processing unit, the tape-surface-inspection unit including:

10 (i) a surface illuminator for illuminating a tape surface,

(ii) an imager for imaging the illuminated tape surface,

(iii) an image processor for processing the tape surface image so as to allow the characterization of the tape surface,

(iv) a tape guide for locating the tape with respect to the imager,

15 and

(v) an indexer for permitting a correlation a location along the tape and a characterization of the location on the tape; and

(d) a controller in communication with the tape-processing unit, the tape handler, and the tape-surface-inspection unit.

20 80. A method for manufacturing a non-transparent tape, said method comprising the steps of:

(a) continuously processing at least non-transparent tape; and

(b) substantially simultaneously continuously characterizing at least one surface of the continuously processed non-transparent tape

25 81. A method for continuously inspecting a surface of a substantially continuously translating non-transparent tape, said method comprising the steps of:

(a) illuminating at least a portion of a surface of the at least one substantially continuously translating non-transparent tape;

(b) imaging the illuminated at least a portion of a surface;

(c) processing the image of the at least a portion of a surface so as to characterize the at least a portion of a surface;

(d) indexing a location of the at least a portion of a surface along the non-transparent tape; and

(f) correlating the indexed location of the at least a portion of a surface and the characterization of the at least a portion of a surface of the non-transparent tape.

82. A method for manufacturing a non-transparent tape, said method comprising the steps of:

(a) continuously processing at least non-transparent tape; and

(b) substantially simultaneously continuously characterizing at least one surface of the continuously processed at least non transparent tape, said characterizing comprising the steps of

(i) illuminating at least a portion of a surface of the at least one continuously translating non-transparent tape;

(ii) imaging the illuminated at least a portion of a surface;

(ii) processing the image of the at least a portion of a surface so as to characterize the at least a portion of a surface;

(iv) indexing a location of the at least a portion of a surface along the non-transparent tape; and

(v) correlating the indexed location of the at least a portion of a surface and the characterization of the at least a portion of a surface of the non-transparent tape.

83. A non-transparent tape useable as substrate in the manufacture of a high temperature superconducting conductor, said non-transparent tape comprising:

(a) a surface finish of about 0.1 to about 10 nm RMS; and

(b) a surface particle area fraction of about 0.5 % to about 10 %.

84. A non-transparent tape according to Claim 83 wherein the tape surface is substantially free of particulates or contamination materials.

85. A non-transparent tape according to Claim 83 wherein the surface roughness is measured by means of an Atomic Force Microscope (AFM).

86. A non-transparent tape according to Claim 83 wherein the surface roughness is measured by means of laser.

87. A non-transparent tape according to Claim 84 wherein the area fraction of particulates or contamination materials is quantified by an image processing software.

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